IN THE TITLE:

The title has been amended herein. Pursuant to 37 C.F.R. §§ 1.121 and 1.125 (as amended to date), please enter the title as amended.

EVAPORATOR FOR A HEAT TRANSFER SYSTEM ~~AND RELATED METHODS~~

IN THE SPECIFICATION:

Please amend paragraph **[0002]** as follows:

[0002] This application is a continuation-in-part of U.S. Patent Application Serial No. 10/602,022, filed Jun. 24, 2003, now U.S. Patent 7,004,240, issued February 28, 2006, which claims the benefit of U.S. Provisional Patent Application Serial No. 60/391,006, filed Jun. 24, 2002 and this application is also a continuation-in-part of U.S. Patent Application Serial No. 09/896,561, filed Jun. 29, 2001, now U.S. Patent 6,889,754, issued May 10, 2005, which claims the benefit of U.S. Provisional Patent Application Serial No. 60/215,588, filed Jun. 30, 2000. The entire disclosure of each of these applications is incorporated herein by reference. This application is also related to U.S. Patent Application Serial No. 12/650,394, filed December 30, 2009, pending, which is a continuation-in-part of the present application and which is a divisional of U.S. Patent Application Serial No. 10/694,387, filed October 28, 2003, now U.S. Patent No. 7,708,053, issued May 4, 2010, which claims the benefit of U.S. Provisional Patent Application Serial No. 60/421,737, filed October 28, 2002. This application is also related to U.S. Patent Application Serial No. 12/426,001, filed April 17, 2009,~~, pending,~~ now U.S. Patent 8,066,055, issued November 29, 2011, which is a continuation of U.S. Patent Application Serial No. 10/890,382, filed July 14, 2004, now U.S. Patent No. 7,549,461, issued June 23, 2009, which claims the benefit of U.S. Provisional Patent Application Serial No. 60/486,467, filed July 14, 2003. This application is also related to U.S. Patent Application Serial No. 11/383,740, filed May 16, 2006,~~, pending,~~ now U.S. Patent 7,931,072, issued April 26, 2011, which is a continuation-in-part of the present application.

Please amend paragraph **[0006]** as follows:

[0006] In one general aspect, an evaporator for a heat transfer system includes a heated wall, a liquid barrier wall, a primary wick positioned between the heated wall and ~~the~~ an inner side of the liquid barrier wall, a vapor removal channel, and a liquid flow channel. The liquid barrier wall contains working fluid on ~~an~~ the inner side of the liquid barrier wall. The fluid flows only along the inner side of the liquid barrier wall. The vapor removal channel is located

at an interface between the primary wick and the heated wall. The liquid flow channel is located between the liquid barrier wall and the primary wick.

Please amend paragraph **[0007]** as follows:

[0007] Implementations may include one or more of the following features. For example, the evaporator may further include additional vapor removal channels located at ~~the~~ an interface between the primary wick and the heated wall. The evaporator may also include additional liquid flow channels located between the liquid barrier wall and the primary wick.

Please amend paragraph **[0010]** as follows:

[0010] The interface at the primary wick may be defined so as to accommodate the vapor removal channel. The vapor removal channel may be electro-etched or machined into ~~a~~ the heated wall. The vapor removal channel may be embedded within the primary wick at the interface.

Please amend paragraph **[0027]** as follows:

[0027] The evaporator may be used in any two-phase heat transfer system for use in terrestrial or extraterrestrial applications. For example, the heat transfer systems can be used in electronic equipment, which often requires cooling during ~~operation~~ operation, or in laser diode applications.

Please amend paragraph **[0030]** as follows:

[0030] A gravity-fed hydro accumulator, as well as its special sizing together with charge amount, are features that can significantly simplify the design and improve ~~the LHP~~ LHP reliability. Simplification of the design, less tolerancing of parts and increasing reliability make it possible to ~~mass produce~~ mass-produce loop heat pipes at the cost of copper-water heat pipes currently produced in the millions ~~a~~ each year for electronics cooling.

Please amend paragraph **[0053]** as follows:

[0053] FIG. 15A is a flat detail view of the ~~liquid barrier~~ heated wall formed into a shell ring component of the annular evaporator of FIG. 14A.

Please amend paragraph **[0054]** as follows:

[0054] FIG. 15B is a cross-sectional view of the ~~liquid barrier~~ heated wall of FIG. 15A taken along section line 15B-15B.

Please amend paragraph **[0059]** as follows:

[0059] FIG. 17A is a perspective view of a ~~heated~~ liquid barrier wall formed into an annular ring of the annular evaporator of FIG. 14A.

Please amend paragraph **[0060]** as follows:

[0060] FIG. 17B is a top view of the ~~heated~~ liquid barrier wall of FIG. 17A.

Please amend paragraph **[0061]** as follows:

[0061] FIG. 17C is a cross-sectional view of the ~~heated~~ liquid barrier wall of FIG. 17B taken along section line 17C-17C.

Please amend paragraph **[0062]** as follows:

[0062] FIG. 17D is an enlarged view of a portion of the ~~heated~~ liquid barrier wall of FIG. 17C.

Please amend paragraph **[0063]** as follows:

[0063] FIG. 18A is a perspective view of a ring separating the ~~heated~~ liquid barrier wall of FIG. 17A from the ~~liquid barrier~~ heated wall of FIG. 15A.

Please amend paragraph **[0076]** as follows:

[0076] The heat transfer system 105 includes a main evaporator 115, and a condenser 120 coupled to the main evaporator 115 by a liquid line 125 and a vapor line 130. The condenser 120 is in thermal communication with a heat sink 165, and the main evaporator 115 is in thermal communication with a heat source ~~Qin~~ $\underline{Q_{in}}$ 116. The heat transfer system 105 may also include a hot reservoir 147 coupled to the vapor line 130 for additional pressure containment, as needed. In particular, the hot reservoir 147 increases the volume of the heat transport system 100. If the working fluid is at a temperature above its critical temperature, that is, the highest temperature at which the working fluid can exhibit liquid-vapor equilibrium, its pressure is proportional to the mass in the heat transport system 100 (the charge) and inversely proportional to the volume of the system. Increasing the volume with the hot reservoir 147 lowers the fill pressure.

Please amend paragraph **[0077]** as follows:

[0077] The main evaporator 115 includes a container 117 that houses a primary wick 140 within which a core 135 is defined. The main evaporator 115 includes a bayonet tube 142 and a secondary wick 145 within the core 135. The bayonet tube 142, the primary wick 140, and the secondary wick 145 define a liquid passage 143, a first vapor passage 144, and a second vapor passage 146. The secondary wick 145 provides phase control, that is, liquid/vapor separation in the core 135, as discussed in U.S. Patent No. 6,889,754, issued May 10, 2005, which is incorporated herein by reference in its entirety. As shown, the main evaporator 115 has three ~~ports,~~ ports: a liquid inlet 137 into the liquid passage 143, a vapor outlet 132 into the vapor line 130 from the second vapor passage 146, and a fluid outlet 139 from the liquid passage 143 (and possibly the first vapor passage 144, as discussed below). Further details on the structure of a three-port evaporator are discussed below with respect to FIGS. 5A and 5B.

Please amend paragraph **[0078]** as follows:

[0078] The priming system 110 includes a secondary or priming evaporator 150 coupled to the vapor line 130 and a reservoir 155 co-located with the secondary evaporator 150. The reservoir 155 is coupled to the core 135 of the main evaporator 115 by a secondary fluid line 160 and a secondary condenser 122. The secondary fluid line 160 couples to the fluid outlet 139 of the main evaporator 115. The priming system 110 also includes a controlled heat source ~~Qsp~~ $\underline{Q_{sp}}$ 151 in thermal communication with the secondary evaporator 150.

Please amend paragraph **[0079]** as follows:

[0079] The secondary evaporator 150 includes a container 152 that houses a primary wick 190 within which a core 185 is defined. The secondary evaporator 150 includes a bayonet tube 153 and a secondary wick 180 that extend from the core 185, through a conduit 175, and into the reservoir 155. The secondary wick 180 provides a capillary link between the reservoir 155 and the secondary evaporator 150. The bayonet tube 153, the primary wick 190, and the secondary wick 180 define a liquid passage 182 coupled to the fluid line 160, a first vapor passage 181 coupled to the reservoir 155, and a second vapor passage 183 coupled to the vapor line 130. The reservoir 155 is thermally and hydraulically coupled to the core 185 of the secondary evaporator 150 through the liquid passage 182, the secondary wick 180, and the first vapor passage 181. Vapor and/or NCG bubbles from the core 185 of the secondary evaporator 150 are swept through the first vapor passage 181 to the reservoir 155 and condensable liquid is returned to the secondary evaporator 150 through the secondary wick 180 from the reservoir 155. The primary wick 190 hydraulically links liquid within the core 185 to the heat source ~~Qsp~~ $\underline{Q_{sp}}$ 151, permitting liquid at an outer surface of the primary wick 190 to evaporate and form vapor within the second vapor passage 183 when heat is applied to the secondary evaporator 150.

Please amend paragraph **[0083]** as follows:

[0083] Referring also to FIG. 3, the heat transport system 100 performs a procedure 300 for transporting heat from the heat source ~~Qin~~ $\underline{Q_{in}}$ 116 and for ensuring that the main

evaporator 115 is wetted with liquid prior to startup. The procedure 300 is particularly useful when the heat transfer system 105 is at a supercritical state. Prior to initiation of the procedure 300, the heat transport system 100 is filled with a working fluid at a particular pressure, referred to as a "fill pressure." Initially, the reservoir 155 is cold-biased by, for example, mounting the reservoir 155 to the heat sink 165 (step 305). The reservoir 155 may be cold-biased to a temperature below the critical temperature of the working fluid, which, as discussed, is the highest temperature at which the working fluid can exhibit liquid-vapor equilibrium. For example, if the fluid is ethane, which has a critical temperature of 33° C., the reservoir 155 is cooled to below 33° C. As the temperature of the reservoir 155 drops below the critical temperature of the working fluid, the reservoir 155 partially fills with a liquid condensate formed by the working fluid. The formation of liquid within the reservoir 155 wets the secondary wick 180 and the primary wick 190 of the secondary evaporator 150 (step 310).

Please amend paragraph **[0084]** as follows:

[0084] Meanwhile, power is applied to the priming system 110 by applying heat from the heat source ~~Qsp~~ $\underline{Q_{sp}}$ 151 to the secondary evaporator 150 (step 315) to enhance or initiate circulation of fluid within the heat transfer system 105. Vapor output by the secondary evaporator 150 is pumped through the vapor line 130 and through the condenser 120 (step 320) due to capillary pressure at the interface between the primary wick 190 and the second vapor passage 183. As vapor reaches the condenser 120, it is converted to liquid (step 325). The liquid formed in the condenser 120 is pumped to the main evaporator 115 of the heat transfer system 105 (step 330). When the main evaporator 115 is at a higher temperature than the critical temperature of the fluid, the liquid entering the main evaporator 115 evaporates and cools the main evaporator 115. This process (steps 315-330) continues, causing the main evaporator 115 to reach a set point temperature (step 335), at which point the main evaporator is able to retain liquid and be wetted and to operate as a capillary pump. In one implementation, the set point temperature is the temperature to which the reservoir 155 has been cooled. In another implementation, the set point temperature is a temperature below the critical temperature of the

working fluid. In a further implementation, the set point temperature is a temperature above the temperature to which the reservoir 155 has been cooled.

Please amend paragraph **[0085]** as follows:

[0085] If the set point temperature has been reached (step 335), the heat transport system 100 operates in a main mode (step 340) in which heat from the heat source ~~Qin~~ Q_{in} 116 that is applied to the main evaporator 115 is transferred by the heat transfer system 105. Specifically, in the main mode, the main evaporator 115 develops capillary pumping to promote circulation of the working fluid through the heat transfer system 105. Also, in the main mode, the set point temperature of the reservoir 155 is reduced. The rate at which the heat transfer system 105 cools down during the main mode depends on the cold biasing of the reservoir 155 because the temperature of the main evaporator 115 closely follows the temperature of the reservoir 155. Additionally, though not required, a heater can be used to further control or regulate the temperature of the reservoir 155 during the main mode. Furthermore, in main mode, the power applied to the secondary evaporator 150 by the heat source ~~Qsp~~ Q_{sp} 151 is reduced, thus bringing the heat transfer system 105 down to a normal operating temperature for the fluid. For example, in the main mode, the heat load from the heat source ~~Qsp~~ Q_{sp} 151 to the secondary evaporator 150 is kept at a value equal to or in excess of heat conditions, as defined below. In one implementation, the heat load from the heat source ~~Qsp~~ Q_{sp} 151 is kept to about 5 to 10% of the heat load applied to the main evaporator 115 from the heat source ~~Qin~~ Q_{in} 116.

Please amend paragraph **[0088]** as follows:

[0088] To reduce the adverse impact of heat conditions discussed above, the priming system 110 operates at a power level ~~Qsp~~ Q_{sp} 151 greater than or equal to the sum of the ~~head~~ heat conduction and the parasitic heat gains. As mentioned above, for example, the priming system can operate at 5-10% of the power to the heat transfer system 105. In particular, fluid that includes a combination of vapor bubbles and liquid is swept out of the core 135 for discharge into the secondary fluid line 160 leading to the secondary condenser 122. In particular, vapor that forms within the core 135 travels around the bayonet tube ~~143~~ 142 directly into the fluid

outlet 139. Vapor that forms within the first vapor passage 144 makes its way into the fluid outlet 139 by either traveling through the secondary wick 145 (if the pore size of the secondary wick 145 is large enough to accommodate vapor bubbles) or through an opening at an end of the secondary wick 145 near the fluid outlet 139 that provides a clear passage from the first vapor passages 144 to the fluid outlet 139. The secondary condenser 122 condenses the bubbles in the fluid and pushes the fluid to the reservoir 155 for reintroduction into the heat transfer system 105.

Please amend paragraph **[0089]** as follows:

[0089] Similarly, to reduce parasitic heat input to the liquid line 125, the secondary fluid line 160 and the liquid line 125 can form a coaxial configuration and the secondary fluid line 160 surrounds and insulates the liquid line 125 from surrounding heat. This implementation is discussed further below with reference to FIGS. 8A and 8B. As a consequence of this configuration, it is possible for the surrounding heat to cause vapor bubbles to form in the secondary fluid line 160, instead of in the liquid line 125. As discussed, by virtue of capillary action ~~affected~~ effected at the secondary wick 145, fluid flows from the main evaporator 115 to the secondary condenser 122. This fluid flow, and the relatively low temperature of the secondary condenser 122, causes a sweeping of the vapor bubbles within the secondary fluid line 160 through the condenser 122, where they are condensed into liquid and pumped into the reservoir 155.

Please amend paragraph **[0090]** as follows:

[0090] ~~As shown in FIG. 4, data~~ Data from a test run is shown in FIG. 4. In this implementation, prior to startup of the main evaporator 115 at ~~temperature~~ time 410, a temperature 400 of the main evaporator 115 is significantly higher than a temperature 405 of the reservoir 155, which has been cold-biased to the set point temperature (step 305). As the priming system 110 is wetted (step 310), power ~~Qsp~~ Q_{sp} 450 is applied to the secondary evaporator 150 (step 315) at a time 452, causing liquid to be pumped to the main evaporator 115 (step 330), the temperature 400 of the main evaporator 115 drops until it reaches the temperature 405 of the reservoir 155 at time 410. Power ~~Qin~~ Q_{in} 460 is applied to the main evaporator 115 at a

time 462, when the heat transport system 100 is operating in LHP mode (step 340). As shown, power input ~~Qin~~ $\underline{Q_{in}}$ 460 to the main evaporator 115 is held relatively low while the main evaporator 115 is cooling down. Also shown are the temperatures 470 and 475, respectively, of the secondary fluid line 160 and the liquid line 125. After time 410, temperatures 470 and 475 track the temperature 400 of the main evaporator 115. Moreover, a temperature 415 of the secondary evaporator 150 follows closely with the temperature 405 of the reservoir 155 because of the thermal communication between the secondary evaporator 150 and the reservoir 155.

Please amend paragraph **[0091]** as follows:

[0091] As mentioned, in one implementation, ethane may be used as the fluid in the heat transfer system 105. Although the critical temperature of ethane is 33° C, for the reasons generally described above, the heat transport system 100 can start up from a supercritical state in which the heat transport system 100 is at a temperature of 70° C. As power ~~Qsp~~ $\underline{Q_{sp}\ 450}$ is applied to the secondary evaporator 150, the temperatures of the condenser 120 and the reservoir 155 drop rapidly (between times 452 and 410). A trim heater can be used to control the temperature of the reservoir 155 and thus the condenser 120 to -10° C. To start up the main evaporator 115 from the supercritical temperature of 70° C, a heat load or power input ~~Qsp~~ $\underline{Q_{sp}}$ of 10 W is applied to the secondary evaporator 150. Once the main evaporator 115 is primed, the power input from the heat source ~~Qsp~~ $\underline{Q_{sp}}$ 151 to the secondary evaporator 150 and the power applied to and through the trim heater both may be reduced to bring the temperature of the heat transport system 100 down to a nominal operating temperature of about -50° C. For instance, during the main mode, if a power input ~~Qin~~ $\underline{Q_{in}\ 460}$ of 40 W is applied to the main evaporator 115, the power input ~~Qsp~~ $\underline{Q_{sp}}$ to the secondary evaporator 150 can be reduced to approximately 3 W while operating at -45° C to mitigate the 3 W lost through heat conditions (as discussed above). As another example, the main evaporator 115 can operate with power input ~~Qin~~ $\underline{Q_{in}}$ from about 10 W to about 40 W with 5 W applied to the secondary evaporator 150 and with the temperature 405 of the reservoir 155 at approximately -45° C.

Please amend paragraph **[0092]** as follows:

[0092] Referring to FIGS. 5A and 5B, in one implementation, the main evaporator 115 is designed as a three-port evaporator 500 (which is the design shown in FIG. 1). Generally, in the three-port evaporator 500, liquid flows into a liquid inlet 505 into a core 510, defined by a primary wick 540, and fluid from the core 510 flows from a fluid outlet 512 to a cold-biased reservoir (such as reservoir 155). The fluid and the core 510 are housed within a container 515 made of, for example, aluminum. In particular, fluid flowing from the liquid inlet 505 into the core 510 flows through a bayonet tube 520, into a liquid passage 521 that flows through and around the bayonet tube 520. Fluid can flow through a secondary wick 525 (such as secondary wick 145 of evaporator 115) made of a wick material 530 and an annular artery 535. The wick material 530 separates the annular artery 535 from a first vapor passage 560. As power from the heat source ~~Qin~~ Q_{in} 116 is applied to the evaporator 500, liquid from the core 510 enters ~~a~~ the primary wick 540 and evaporates, forming vapor that is free to flow along a second vapor passage 565 that includes one or more vapor grooves 545 and out a vapor outlet 550 into the vapor line 130. Vapor bubbles that form within first vapor passage 560 of the core 510 are swept out of the core 510 through the first vapor passage 560 and into the fluid outlet 512. As discussed above, vapor bubbles within the first vapor passage 560 may pass through the secondary wick 525 if the pore size of the secondary wick 525 is large enough to accommodate the vapor bubbles. Alternatively, or additionally, vapor bubbles within the first vapor passage 560 may pass through an opening of the secondary wick 525 formed at any suitable location along the secondary wick 525 to enter the liquid passage 521 or the fluid outlet 512.

Please amend paragraph **[0093]** as follows:

[0093] Referring to FIG. 6, in another implementation, the main evaporator 115 is designed as a four-port evaporator 600, which is a design described in U.S. Patent No. 6,889,754, issued May 10, 2005. Briefly, and with emphasis on aspects that differ from the three-port evaporator configuration, liquid flows into the evaporator 600 through a fluid inlet 605, through a bayonet 610, and into a core 615. The liquid within the core 615 enters a primary wick 620 and evaporates, forming vapor that is free to flow along vapor grooves 625 and out a vapor outlet 630

into the vapor line 130. A secondary wick 633 within the core 615 separates liquid within the core 615 from vapor or bubbles in the core 615 (that are produced when liquid in the core 615 heats). The liquid-carrying bubbles formed within a first fluid passage 635 inside the secondary wick 633 flows out of a fluid outlet 640 and the vapor or bubbles formed within a vapor passage 642 positioned between the secondary wick 633 and the primary wick 620 flow out of a vapor outlet 645.

Please amend paragraph **[0096]** as follows:

[0096] In one implementation, the vapor line 130 is made with ~~smooth walled~~ smooth-walled stainless steel tubing having an outer diameter (OD) of 3/16 inch and the liquid line 125 and the secondary fluid line 160 are made of smooth-walled stainless steel tubing having an OD of 1/8 inch. The lines 125, 130, 160 may be bent in a serpentine route and plated with gold to minimize parasitic heat gains. Additionally, the lines 125, 130, 160 may be enclosed in a stainless steel box with heaters to simulate a particular environment during testing. The stainless steel box can be insulated with multi-layer insulation (MLI) to minimize heat leaks through panels of the heat sink 165.

Please amend paragraph **[0099]** as follows:

[0099] Referring to FIGS. 8A-8D, the heat transport system 100 may be implemented in a miniaturized cryogenic system 800. In the miniaturized system 800, the lines 125, 130, 160 are made of flexible material to permit coil configurations 805, which save space. The miniaturized system 800 can operate at -238° C using neon fluid. Power input ~~Qin~~ Q_{in} 116 is approximately 0.3 W to 2.5 W. The miniaturized system 800 thermally couples a cryogenic component (or heat source that requires cryogenic cooling) 816 to a cryogenic cooling source, such as a cryocooler 810, coupled to cool the condensers 120, 122.

Please amend paragraph **[00101]** as follows:

[00101] Moreover, the miniaturized system 800 can function over a wide range of heat transport distances, which permits a configuration in which the cooling source (such as the

cryocooler 810) is located remotely from the cryogenic component 816. The coil configurations 805 have a low mass and low surface area, thus reducing parasitic heat gains through the lines 125 and 160. The configuration of the cooling source 810 within miniaturized system 800 facilitates integration and packaging of the system 800 and reduces vibrations on the cooling source 810, which becomes particularly important in infrared sensor applications. In one implementation, the miniaturized system 800 was tested using neon, operating at ~~25-~~ 25K to 40K.

Please amend paragraph **[00102]** as follows:

[00102] Referring to FIGS. 9A-9C, the heat transport system 100 may be implemented in an adjustable mounted or Gimbaled system 1005 in which the main evaporator 115 and a portion of the lines 125, 160, and 130 are mounted to rotate about an elevation axis within a range of ±45° and a portion of the lines 125, 160, and 130 are mounted to rotate about an azimuth axis 1025 within a range of ±220°. The lines 125, 160, 130 are formed from thin-walled tubing and are coiled around each axis of rotation. The system 1005 thermally couples a cryogenic component (or heat source that requires cryogenic cooling), such as a sensor 1016 of a cryogenic telescope, to a cryogenic cooling source, such as a cryocooler 1010, coupled to cool the condensers 120, 122. The cooling source 1010 is located at a stationary spacecraft 1060, thus reducing mass at the cryogenic telescope. Motor torque for controlling rotation of the lines 125, 160, 130, power requirements of the system 1005, control requirements for the spacecraft 1060, and pointing accuracy for the sensor 1016 are improved. The cryocooler 1010 and the radiator or heat sink 165 can be moved from the sensor 1016, reducing vibration within the sensor 1016. In one implementation, the system 1005 was tested to operate within the range of ~~70-~~ 70K to 115K when the working fluid is nitrogen.

Please amend paragraph **[00107]** as follows:

[00107] Evaporators are integral components in two-phase heat transfer systems. For example, as shown above in FIGS. 5A and 5B, the evaporator 500 includes an evaporator body or container 515 that is in contact with the primary wick 540 that surrounds the core 510. The

core 510 defines a flow passage 522 for the working fluid. The primary wick 540 is surrounded at its periphery by a plurality of peripheral flow channels or vapor grooves 545. The channels 545 collect vapor at the interface between the wick 540 and the evaporator body 515. The channels 545 are in contact with the vapor outlet 550 that feeds into the vapor line 130 that feeds into the condenser 120 to enable evacuation of the vapor formed within the evaporator 115.

Please amend paragraph **[00111]** as follows:

[00111] Referring to FIG. 10, an evaporator 1000 for a heat transfer system includes a heated wall 1007, a liquid barrier wall ~~1010,~~ 1011, a primary wick 1015 between the heated wall 1007 and ~~the~~ an inner side of the liquid barrier wall ~~1010,~~ 1011, vapor removal channels 1020, and liquid flow channels 1025.

Please amend paragraph **[00112]** as follows:

[00112] The heated wall 1007 is in intimate contact with the primary wick 1015. The liquid barrier wall ~~1010~~ 1011 contains working fluid on ~~an~~ the inner side of the liquid barrier wall ~~1010,~~ 1011, such that the working fluid flows only along the inner side of the liquid barrier wall ~~1010.~~ 1011. The liquid barrier wall ~~1010~~ 1011 closes the evaporator's envelope and helps to organize and distribute the working fluid through the liquid flow channels 1025. The vapor removal channels 1020 are located at an interface between a vaporization surface 1017 of the primary wick 1015 and the heated wall 1007. The liquid flow channels 1025 are located between the liquid barrier wall ~~1010~~ 1011 and the primary wick 1015.

Please amend paragraph **[00115]** as follows:

[00115] The vapor removal channels 1020 are shown as grooves in the inner side of the heated wall 1007. However, the vapor removal channels 1020 can be designed and located in several different ways, depending on the design approach chosen. For example, according to other implementations, the vapor removal channels 1020 are grooved into the outer surface of the primary wick 1015 or embedded into the primary wick 1015, such that they are under the surface of the primary wick 1015. The design of the vapor removal channels 1020 is selected to increase

the ease and convenience of manufacturing and to closely approximate one or more of the following guidelines.

Please amend paragraph **[00116]** as follows:

[00116] First, the hydraulic diameter of the vapor removal channels 1020 should be sufficient to handle a vapor flow generated on the vaporization surface 1017 of the primary wick 1015 without a significant pressure drop. Second, the surface of contact between the heated wall 1007 and the primary wick 1015 should be maximized to provide efficient heat transfer from the heat source to vaporization surface 1017 of the primary wick 1015. Third, a thickness 1030 of the heated wall 1007, which is in contact with the primary wick 1015, should be minimized. As the thickness 1030 increases, vaporization at the surface 1017 of the primary wick 1015 is reduced and transport of vapor through the vapor removal channels 1020 is reduced.

Please amend paragraph **[00117]** as follows:

[00117] The evaporator 1000 can be assembled from separate parts. Alternatively, the evaporator 1000 can be made as a single part by in-situ sintering of the primary wick 1015 between two walls having special mandrels to form channels on both sides of the wick 1015.

Please amend paragraph **[00118]** as follows:

[00118] The primary wick 1015 provides the vaporization surface 1017 and pumps or feeds the working fluid from the liquid flow channels 1025 to the vaporization surface 1017 of the primary wick 1015.

Please amend paragraph **[00122]** as follows:

[00122] One method is an organized heat exchange between the reservoir and the environment. For evaporators having a planar design, such as those often used for terrestrial applications, the heat transfer system includes heat exchange fins on the reservoir and/or on the liquid barrier wall ~~1010~~ 1011 of the evaporator 1000. The forces of natural convection on these

fins provide subcooling and reduce stress on the condenser and the reservoir of the heat transfer system.

Please amend paragraph **[00128]** as follows:

[00128] Heat conduction through the primary wick 1015 may initiate vaporization of the working fluid in the wrong place -- on a liquid side of the evaporator 1000 near or within the liquid flow channels 1025. The vapor vent channel 1045 delivers the unwanted vapor away from the wick 1015 into the two-phase reservoir.

Please amend paragraph **[00133]** as follows:

[00133] The heated wall 1105 is in intimate contact with the primary wick 1115. The liquid barrier wall 1110 contains working fluid on an inner side of the liquid barrier wall 1110 such that the working fluid flows only along the inner side of the liquid barrier wall 1110. The liquid barrier wall 1110 closes the evaporator's envelope and helps to organize and distribute the working fluid through the liquid flow channels 1125.

Please amend paragraph **[00145]** as follows:

[00145] The evaporator 1305 is attached to the hot side 1300 of the Stirling engine or any other heat-rejecting device. This attachment can be ~~integral~~ integral, in that the evaporator 1305 can be an integral part of the ~~engine~~ engine, or the attachment can be ~~non-integral~~ non-integral, in that the evaporator 1305 can be clamped to an outer surface of the hot side 1300. The heat transfer system 1310 is cooled by a forced convection sink, which can be provided by a simple fan 1370.

Please amend paragraph **[00148]** as follows:

[00148] The liquid flow channels of the evaporator 1305 can be replaced by a simple annulus, if the cold biasing discussed above is sufficient to compensate the increased heat leak across the primary wick 1345, which is caused by the increase in surface area of the heat exchange surface ~~of~~ of the annulus versus the surface area of the liquid flow channels.

Please amend paragraph **[00149]** as follows:

[00149] Referring also to FIGS. 14A-14F, an annular evaporator 1400 is shown having a liquid inlet 1455 and a vapor outlet 1460. The annular evaporator 1400 includes a heated wall 1700 (FIGS.~~17A-17D~~ 14E, 14F, 15A, and 15B), a liquid barrier wall 1500 (FIGS.~~15A and 15B~~ 14E, 14F, and 17A-D), a primary wick 1600 (FIGS. 16A-16D) positioned between the heated wall 1700 and the inner side of the liquid barrier wall 1500, vapor removal channels~~(not shown)~~ 1465 (FIGS. 15A and 15B), and liquid flow channels 1505 (FIG.~~15B~~ 14E). The annular evaporator 1400 also includes a ring 1800 (FIGS. 18A-18D) that ensures spacing between the heated wall 1700 and the liquid barrier wall 1500 and a ring 1900 (FIGS. 19A-19D) at a base of the evaporator 1400 that provides support for the liquid barrier wall 1500 and the primary wick 1600.